
Space Weather Technical Forecast

Issued on Monday, 03 June 2024 at 00:19 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Moderate activity with a chance of X-class flares. Glancing CME impacts possible into the period with a chance of G1/G2 Minor or Moderate Geomagnetic Storms.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate during the last 24 hours, with two M-class flares from AR3697, the largest of which peaked at 02/0850 UTC at M2.0. There are now eight numbered spots on the disc and one unnumbered, with AR36702 numbered within the period. AR3697 in the southeast remains the largest and most geomagnetically complex region. The next most complex groups are AR3695 and AR3701, both moderately magnetically complex. AR3700 continues to show slight growth and consolidation of its spots. Other regions on the disc are smaller, simpler and either are stable or have shown only slight changes. There are also currently a number of large and significant filaments of the solar disc.

No Earth-directed CMEs have been observed in available imagery.

Solar Wind / Geomagnetic Activity: Observations by ACE at L1 showed speeds persisting at background at 300-350 km/s, with density largely below average for the first half of the day and then increasing to predominantly average levels. The Interplanetary Magnetic Field, Bt, was weak, 3-6nT with the north-south component, Bz, also varying weakly. Phi angle was generally negative (towards the Sun), briefly rotating to be slightly positive (away from the Sun) at times. Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux at GOES18 remained at background levels with no solar radiation storms occurring. High energy electron flux (greater than 2MeV) at GOES16 was at background to moderate levels with the associated 24-hour fluence well below the Active threshold. Observed fluence at 03/0000 UTC was 3.64e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is forecast with further M-class expected and a chance of isolated or X-class flares, mainly from AR3697 in the southeast.

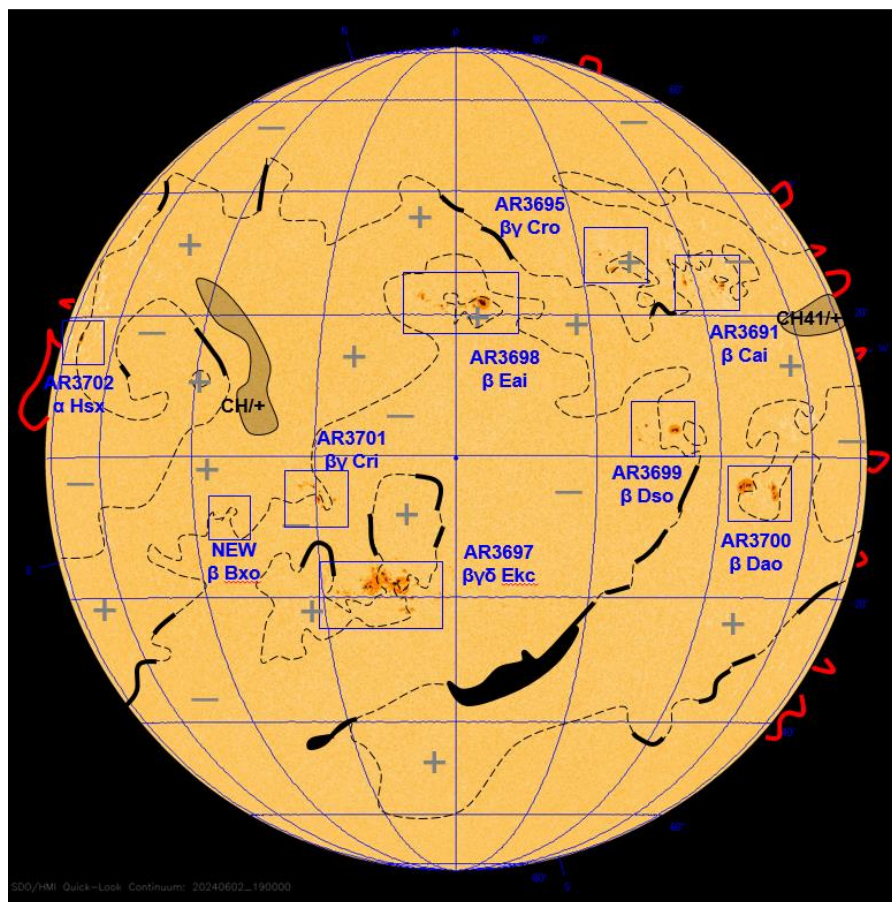
Solar Wind / Geomagnetic Activity: A weak CME from the C7.5 flare of AR3698 on 31 May is expected early day today (3rd Jun), although confidence is low with the strength of any arrival due to the faint and apparent weak nature of the CME. Analysis of a CME associated with the long period M7.3 flare from AR3697, peaking at 01/1940 UTC, suggests the potential for a glancing impact sometime later tomorrow (04 Jun). Otherwise largely background winds are likely to persist, with a chance of becoming slightly enhanced for a time today with any onset of the fast wind of small CH41/+, however this is also low confidence.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

Geomagnetic activity is forecast to be mainly Quiet (Kp 0-2) initially, but perhaps increasing to give Unsettled to Active (Kp 3-4) intervals with any fast wind onset today (3rd Jun) or weak CME arrival, with a slight chance of G1/Minor Storm (Kp 5) intervals. The risk of Active conditions increases into day 2 (4th Jun), with an increased chance of G1-G2 Minor to Moderate (Kp 5-6) Storm intervals associated with any CME arrival, this risk easing into day 3 (5th Jun). Day 4 (6th June) mainly Quiet conditions are expected to return.

Energetic Particles / Solar Radiation: High energy proton flux is expected to persist at background, but with a slight chance of rising above the S1/Minor Storm threshold given any notable flares. High energy electron flux is forecast to persist at background, with the associated 24 hour fluence forecast to remain below the Active threshold.

Figure 1. Solar Analysis Valid 02/1900 UTC.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

A faint partial halo CME was observed on 31st May, perhaps from the C7.5 flare of AR3698. This is very low confidence, due to the indistinct nature of the CME on imagery, but brings the potential for a weak arrival early today (3rd Jun).

The X1.0 flare of AR3697 at 01/1836 UTC was followed by a sympathetic, long period M7.3 flare from the same region, peaking at 01/1940 UTC, with Type II and IV Radio Emissions observed with the second of these flares. A full-halo CME was observed from Earth's frame of reference around the time of the first flare but has been assessed as far-sided, with the second flare resulting in a smaller partial halo CME, potentially Earth-directed but apparently more displaced towards the south and east. Analysis of this second feature suggest the potential for a glancing impact sometime later tomorrow (4th Jun).

Current background solar winds may see a temporary very weak enhancement from CH41/+ today (3rd Jun), perhaps becoming slightly elevated, although confidence is very low regarding this due to the position of CH41 as it approaches the northwest limb. Any slight enhancement would ease to background again later today in the absence of any CME enhancement. This high speed stream feature is currently overestimated in current MOSWOC ENLIL output, leading to reduced confidence in any potential connection, but also in the arrival times of forecast Earth-directed CMEs.

There are also a number of large filaments currently on the Earth-facing disc. These will be closely monitored for any potential Earth-directed eruptions should any of these features lift-off of the solar surface.

Geomagnetic activity is forecast to be mainly Quiet (Kp 0-2) initially, but perhaps increasing to give Unsettled to Active (Kp 3-4) intervals with any fast wind onset today (3rd Jun) or weak CME arrival, with a slight chance of G1/Minor Storm (Kp 5) intervals. The risk of Active conditions increases into day 2 (4th Jun), with an increased chance of G1-G2 Minor to Moderate (Kp 5-6) Storm intervals associated with any CME arrival, this risk easing into day 3 (5th Jun). Day 4 (6th June) mainly Quiet conditions are expected to return.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	10	60	30	5
Strong	G3	No	1	5	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
31/1205	Partial	C7.5 Flare	NE	710 km/s	03/0000 UTC +/- 9 hrs	Low confidence
02/0048	Partial	M7.3 Flare	SE	700 km/s	04/2100 UTC +/- 12 hrs	Glancing blow

Figure 2: Met Office MOSWOC Enlil model

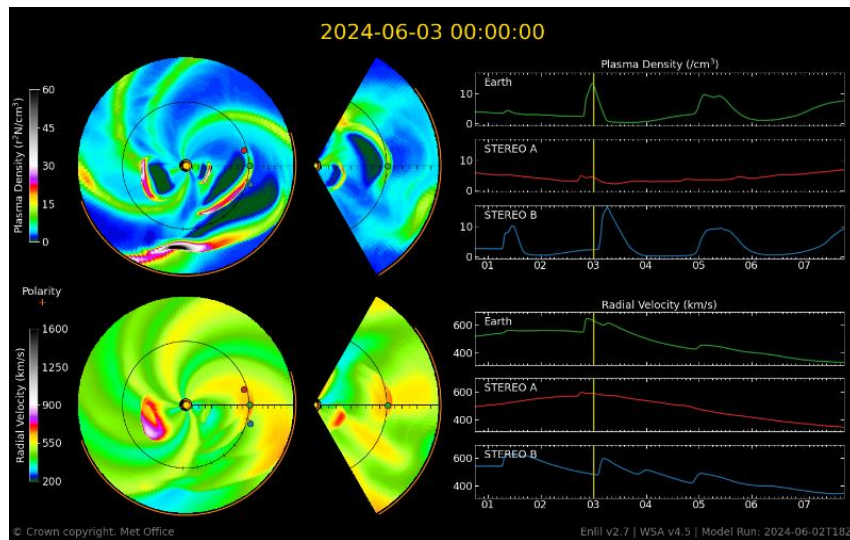
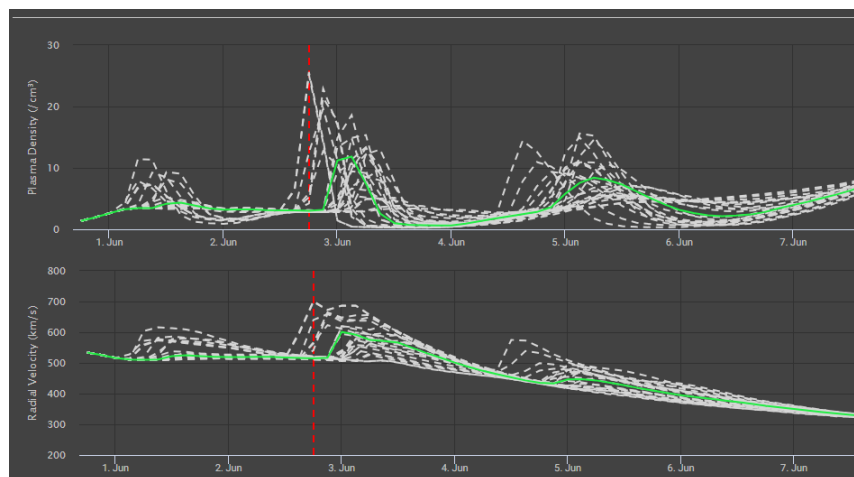


Figure 3: Met Office MOSWOC Enlil Ensembles indicating the range of possible CME arrivals from the CME's that left the Sun on the 31st May and 2nd June.



Radio Blackouts - X-Ray Flares:

There are now eight numbered spots on the disc, with AR3690 having faded from sight. AR3697 in the southeast remains the most notable spot, by far the largest region and also the most magnetically complex with multiple delta spots, although most delta spots are small, including a recently developed delta spot. The next most complex groups are AR3695 and AR3701, both moderately magnetically complex with beta-gamma classifications. AR3700 continues to show slight growth and consolidation of its spots. Other regions on the disc are smaller, simpler and either are stable or have shown only slight changes.

Solar activity has been Moderate during the last 24 hours, with two M-class flares from AR3697, the largest of which peaked at 02/0850 UTC at M2.0. This region brings a likelihood of further M or isolated X-class flares, with the X-flare risk level increased from the raw value due to the history of AR3697. The risk of flares remains constant through the period while AR3697 remains on the visible disc. Elsewhere on the disc, isolated M-flares are also possible, most likely from AR3691, AR3697 and AR3701.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	75	75	75	75
Very Active	R3 to R5 X Class	No	30	30	30	30

Solar Radiation Storms - (High Energy Protons):

GOES-18 high energy proton flux is currently at background, with no response observed from the X-flares of AR3697 on 31 May and 01 Jun. This region, however, continues to have the potential for stronger flares, with an steadily improving position for any such flares to eject Earth-directed high energy protons as it transits into the western hemisphere. There is a slight chance of proton flux enhancement occurring and reaching the S1 Minor Storm threshold. Given the potential for stronger flares, it also cannot be completely ruled out that any such proton storm could exceed the strong threshold (S3 Strong radiation storm).

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	20	20	20	20
Very Active	≥ S3 *	No	5	5	5	5

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)

High Energy Electrons Event ($\geq 2\text{MeV}$):

The high energy electron flux, as observed by GOES-16, is expected to persist at mainly background, with no notable sources of potential enhancement currently anticipated. The associated 24 hour electron fluence is expected to remain well below the Active level, as supported by MOSWOC REFM, which is currently thought to be giving good guidance.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	1	1
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 4: Met Office REFM model

